THE CLAIMS

1. In a digitized tomosynthesis method for obtaining 3D volumetric imaging of an object in which a ray of energy from a source travels through the object to impinge on an energy sensor defining an image plane and in which the object is rotated about an axis whereby an image is acquired by the energy sensor at successive rotational positions of the object, the improvement according to which the object is rotated about an axis of rotation at a canted angle with respect to the image plane.

2. The method of claim 1 in which the energy is in the form of electromagnetic radiation.

3. The method of claim 2 in which the electromagnetic radiation is x-ray radiation.

4. The method of claim 1 in which the energy sensor is a flat panel digital detector.

5. The method of claim 1 in which the optical axis of the source is perpendicular to the image plane.

6. The method of claim 1 in which a ray of energy from the source is mathematically traced through a voxel of the object space to the image plane, the coordinate of the shadow of the voxel on the image plane is computed for each object rotation, and the image data is extracted and combined to form the object space voxel.

7. The method of claim 1 including determining the source and object angles relative to the energy sensor, comprising:

determining the axis of rotation of the object;

placing a first registration marker that is substantially opaque to the energy on a first location proximate the sensor and along the object's axis of rotation;

obtaining a first shadow image corresponding to the first registration marker by exposing the first registration marker to energy from the energy source;

placing a second registration marker that is substantially opaque to energy levels at a location distal from the sensor, spaced a predetermined distance from said first

location along the object's axis of rotation;

obtaining a second shadow image corresponding to the second registration marker by exposing the second registration marker to energy from the energy source; and

comparing a location of the first shadow image and a location of the second shadow image to determine the source and object angles relative to the energy sensor.

8. The method of claim 7 wherein the first registration marker and the second registration marker are the same marker.

9. The method of claim 8 wherein the second registration marker is supported at the predetermined distance by a pedestal.

10. The method of claim 9 wherein the pedestal is substantially transparent to said ray of energy.

11. The method of claim 7 wherein the orientation between the energy source and the sensor surface comprises information including at least one of an angle of misalignment and an angle of inclination of the rotational axis of the object.

12. The method of claim 11 wherein the orientation between the energy source and the sensor surface comprises both the angle of misalignment and the angle of inclination of the rotational axis of the object

13. The method of claim 7 further comprising the steps of:

positioning an object proximate the surface of the energy sensor;

obtaining one or more object shadow images with the energy sensor by exposing the object to energy from the energy source; and

manipulating the one or more object shadow images as a function of the orientation between the energy source and the sensor surface.

14. The method of claim 13 further comprising the steps of: rotating at least one of the energy source and the object about a center of rotation to a plurality of rotational positions; obtaining an object shadow image at each of the plurality of rotational positions by exposing the object to energy from the energy source at each of

the plurality of rotational positions; combining object shadow images obtained at the plurality of rotational positions to obtain a three-dimensional image of the object; and manipulating the three-dimensional image of the object as a function of the orientation between the energy source, the rotational axis of the object, and the sensor surface.

15. In a digitized tomosynthesis system for obtaining 3D volumetric imaging of an object in which a ray of energy from a source travels through the object to impinge on an energy sensor defining an image plane and in which the object is rotated about an axis whereby an image is acquired by the energy sensor at successive rotational positions of the object, the improvement according to which the system includes a support for the object enabling the object to be rotated about an axis of rotation at a canted angle with respect to the image plane.

16. The system of claim 15 in which the energy is in the form of electromagnetic radiation.

17. The system of claim 16 in which the electromagnetic radiation is x-ray radiation.

18. The system of claim 15 in which the energy sensor is a flat panel digital detector.

19. The system of claim 15 in which the optical axis of the source is perpendicular to the image plane.

20. The system of claim 15 including a computer chip containing one or more computer programs for enabling a ray of energy from the source to be mathematically traced through a voxel of the object space to the image plane, for computing the coordinate of the shadow of the voxel on the image plane for each object rotation, and for extracting the image data, and for combining the extracted image data to form the object space voxel.

21. The system of claim 15 enabling the source and object angles to be determined relative to the energy sensor, the system further comprising:

at least one mechanism for determining the axis of rotation of the object;

a first registration marker that is substantially opaque to the energy disposed on a first location proximate the sensor and along the object's axis of rotation whereby to enable a first shadow image corresponding to the first registration marker to be obtained when the first registration marker is exposed to energy from the energy source; and

a second registration marker that is substantially opaque to energy levels disposed at a location distal from the sensor, spaced a predetermined distance from said first location along the object's axis of rotation whereby to enable a second shadow image corresponding to the second registration marker to be obtained by exposing the second registration marker to energy from the energy source;

said one or more computer programs being capable of comparing a location of the first shadow image and a location of the second shadow image to determine the source and object angles relative to the energy sensor.

22. The system of claim 21 wherein the first registration marker and the second registration marker are the same marker.

23. The system of claim 22 wherein the second registration marker is supported at the predetermined distance by a pedestal.

24. The system of claim 23 wherein the pedestal is substantially transparent to said ray of energy.

25. The system of claim 21 wherein the orientation between the energy source and the sensor surface comprises information including at least one of an angle of misalignment and an angle of inclination of the rotational axis of the object.

26. The system of claim 25 wherein the orientation between the energy source and the sensor surface comprises both the angle of misalignment and the angle of inclination of the rotational axis of the object

27. The system of claim 21 further comprising:

an object positioned proximate the surface of the energy sensor; and

a mechanism for obtaining one or more object shadow images with the energy sensor by exposing the object to energy from the energy source;

said one or more computer programs being capable of manipulating the one or more object shadow images as a function of the orientation between the energy source and the sensor surface.

28. The system of claim 27 further comprising a mechanism for rotating at least one of the energy source and the object about a center of rotation to a plurality of rotational positions, and obtaining an object shadow image at each of the plurality of rotational positions by exposing the object to energy from the energy source at each of the plurality of rotational positions; and said one or more computer programs being capable of combining object shadow images obtained at the plurality of rotational positions to obtain a three-dimensional image of the object, and manipulating the three-dimensional image of the object as a function of the orientation between the energy source, the rotational axis of the object, and the sensor surface.

29. An apparatus for representing an internal structure of an object by digitized tomosynthesis in which a ray of energy from a source travels through an object to impinge on an energy sensor defining an image plane and in which the object is rotated about an axis whereby a 3D volumetric imaging of an object is acquired by the energy sensor at successive rotational positions of the object, the improvement according to which the apparatus includes a support for the object enabling the object to be rotated about an axis of rotation at a canted angle with respect to the image plane.

30. The apparatus of claim 15 in which the energy is in the form of electromagnetic radiation.

31. The apparatus of claim 16 in which the electromagnetic radiation is x-ray radiation.

32. The apparatus of claim 15 in which the energy sensor is a flat panel digital detector.

33. The apparatus of claim 15 in which the optical axis of the source is perpendicular to the image plane.

34. The apparatus of claim 15 including a computer chip containing one or more computer programs for enabling a ray of energy from the source to be mathematically traced through a voxel of the object space to the image plane, for computing the coordinate of the shadow of the voxel on the image plane for each object rotation, and for extracting the image data, and for combining the extracted image data to form the object space voxel.

35. The apparatus of claim 15 enabling the source and object angles to be determined relative to the energy sensor, the apparatus further comprising:

at least one mechanism for determining the axis of rotation of the object;

a first registration marker that is substantially opaque to the energy disposed on a first location proximate the sensor and along the object's axis of rotation whereby to enable a first shadow image corresponding to the first registration marker to be obtained when the first registration marker is exposed to energy from the energy source; and

a second registration marker that is substantially opaque to energy levels disposed at a location distal from the sensor, spaced a predetermined distance from said first location along the object's axis of rotation whereby to enable a second shadow image corresponding to the second registration marker to be obtained by exposing the second registration marker to energy from the energy source;

said one or more computer programs being capable of comparing a location of the first shadow image and a location of the second shadow image to determine the source and object angles relative to the energy sensor.

36. The apparatus of claim 21 wherein the first registration marker and the second registration marker are the same marker.

37. The apparatus of claim 22 wherein the second registration marker is supported at the predetermined distance by a pedestal.

38. The apparatus of claim 23 wherein the pedestal is substantially transparent to said ray of energy.

39. The apparatus of claim 21 wherein the orientation between the energy source and the sensor surface comprises information including at least one of an angle of misalignment and an angle of inclination of the rotational axis of the object.

40. The apparatus of claim 25 wherein the orientation between the energy source and the sensor surface comprises both the angle of misalignment and the angle of inclination of the rotational axis of the object

41. The apparatus of claim 21 further comprising:

an object positioned proximate the surface of the energy sensor; and

a mechanism for obtaining one or more object shadow images with the energy sensor by exposing the object to energy from the energy source;

said one or more computer programs being capable of manipulating the one or more object shadow images as a function of the orientation between the energy source and the sensor surface.

42. The apparatus of claim 27 further comprising a mechanism for rotating at least one of the energy source and the object about a center of rotation to a plurality of rotational positions, and obtaining an object shadow image at each of the plurality of rotational positions by exposing the object to energy from the energy source at each of the plurality of rotational positions; and said one or more computer programs being capable of combining object shadow images obtained at the plurality of rotational positions to obtain a three-dimensional image of the object, and manipulating the three-dimensional image of the object as a function of the orientation between the energy source, the rotational axis of the object, and the sensor surface.